Dependence of Achievable \( \beta_N \) on Discharge Shape and Edge Safety Factor in DIII-D Steady-State Scenario Discharges

J.R. FERRON, T.C. LUCE, P.A. POLITZER, General Atomics, R. JAYAKUMAR, LLNL, M.R. WADE, ORNL — One line of research in the DIII-D program is development of a high bootstrap-current-fraction \((f_{BS})\) discharge which can be sustained in steady-state with the addition of electron cyclotron current drive (ECCD). High \( f_{BS} \) requires high normalized beta \((\beta_N)\) and effective ECCD requires low electron density \((n_e)\). Target values of \( \beta_N \) are above the limit that would be predicted by theory for ideal, \( n = 1 \) kink modes without a conducting wall so \( \beta_N \) is often limited by \( n = 1 \) resistive wall modes. When discharge shape changes (lower triangularity and elongation) were made to optimize cryopumping to reduce \( n_e \) the achievable \( \beta_N \) values were reduced by about 10% to \( \approx 3.4 \). An increase in \( q_{95} \) of about 15% to near the original value, made by increasing the toroidal field, resulted in consistently higher values of \( \beta_N > 4 \). A similar increase in \( \beta_N \) could not be made by adjusting the shape within the constraints of the cryopumping geometry. Comparison with predictions of ideal MHD theory are presented.

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